(12) UK Patent Application (19) GB (11) 2 175 685 A

(43) Application published 3 Dec 1986

(21) Application No 8513635

(22) Date of filing 30 May 1985

(51) INT CL⁴
G05D 23/00 F28D 7/00 F28F 27/00

(52) Domestic classification (Edition H):
F4U 24AX
F4S 14
U1S 1451 F4S F4U

(56) Documents cited
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GB 1130795 GB 0743482 GB 0535606
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(58) Field of search
F4U
F4S

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(54) Heat exchange arrangement

(57) Chambers 15,16,17 each contain a passage for water from an inlet 13 to an outlet 14, and a passage for exhaust gas from an inlet 11 to an outlet 12. Valves 1 to 9 determine whether water passes through any of the chambers 15,16,17 or through a bypass passage 18. Thus the outlet temperature of the exhaust gas is maintained within a predetermined range.

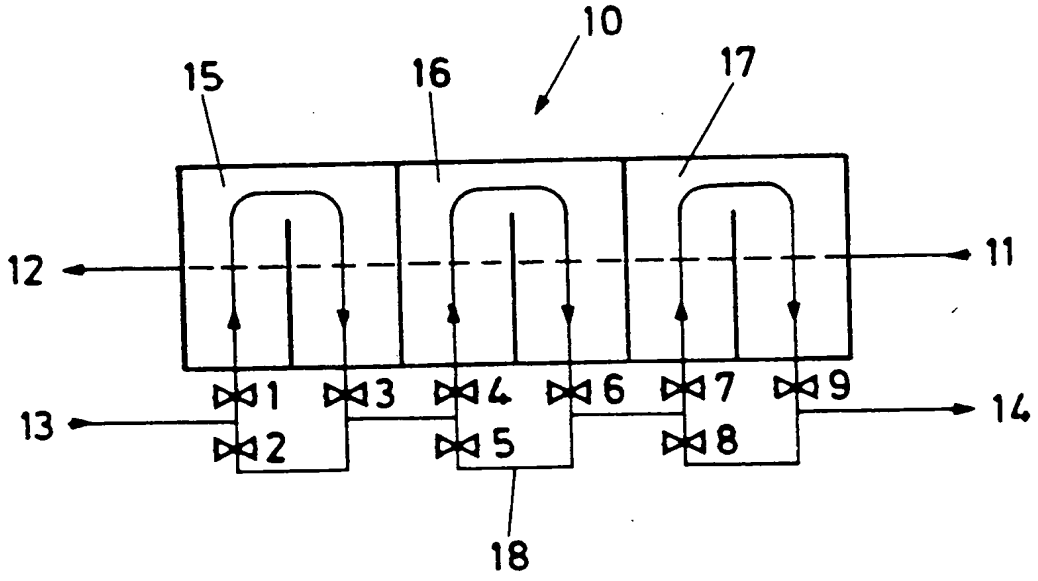

FIG. 1

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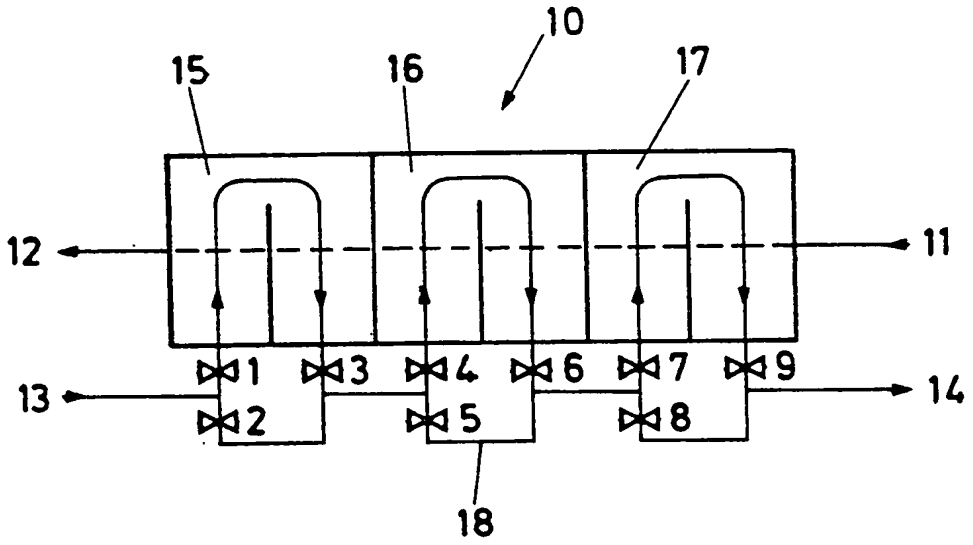
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FIG. 1

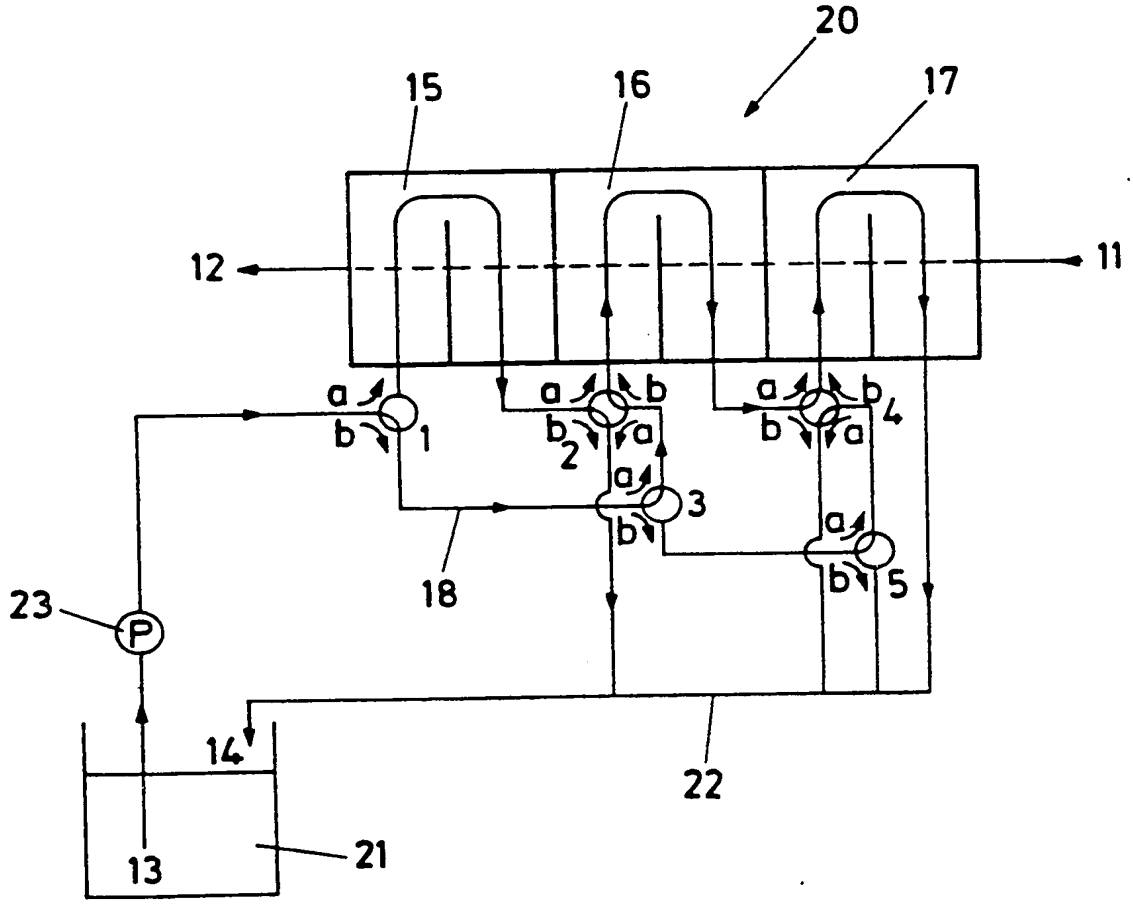
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FIG. 2

SPECIFICATION

Heat exchangers

The invention relates to heat exchangers which are capable of maintaining the temperature at an outlet port of a fluid within a certain range.

The invention provides a heat exchanger comprising a number of portions, a passage for a fluid through the portions, a bypass passage, and valves for selecting whether the fluid passes through any of the portions or the bypass.

By providing a number of heat exchanger portions, it is possible to do without a temperature sensor at a fluid outlet, and so to provide good control of the outlet temperatures in a predetermined range. The resulting heat exchanger may be relatively small in size and compact.

DRAWINGS:

Figure 1 is a schematic view of a first heat exchanger according to the invention; and

Figure 2 is a similar view of a second such heat exchanger.

Fig. 1 shows a heat exchanger 10 in which exhaust gas flows from an inlet port 11 to an outlet port 12, and coolant water flows from an inlet port 13 to an outlet port 14. The heat exchanger 10 is divided into three chambers, i.e. a first chamber 15, second chamber 16 and third chamber 17. There is a bypass passage 18 for the water. Valves 1, 3 are provided at inlet and outlet ports for water at the first chamber 15, valves 4, 6 similarly at the second chamber 16, and valves 7, 9 at the third chamber 17. A valve 2 is disposed in the bypass passage 18 between the valves 1, 3, a valve 5 similarly between the valves 4, 6 and a valve 8 between the valves 7, 9. The valves are opened and closed so as to determine whether water flows through each of the chambers 15, 16, 17 or the bypass passage 18.

The following four modes can be attained by combinations of open (O) and closed (C) states of the valves 1 to 9.

Mode	Chamber in which water flows	1	2	3	4	5	6	7	8	9
1	1,2,3 chambers	O	C	O	O	C	O	O	C	O
2	2,3 chambers	C	O	C	O	C	O	O	C	O
3	3 chamber	C	O	C	C	O	C	O	C	O
4	None	C	O	C	C	O	C	C	O	C

When the temperature of the exhaust gas at the inlet port 11 is increased for example in mode 2 the temperature at the outlet port 12 is also increased. When the temperature at the outlet port 12 approaches an upper limit of the temperature range which is to be maintained, the combination of the open and closed states of the valves is changed to mode 1. Accordingly, the chambers in which the water flows are increased from the second and third chambers 16, 17 to the first, second and third chambers 15, 16, 17. This means, the heat transfer area is increased, and consequently the heat exchanger effectiveness is increased. The temperature at the outlet port 12 is decreased below that in mode 2 and so does not exceed the upper limit of the temperature range which is to be maintained.

When the temperature of the exhaust gas at the inlet port 11 is decreased in mode 2, the temperature at the outlet port 12, is also decreased. When the temperature at the outlet port 12 approaches a lower limit of the temperature range (normally condensing temperature) which is to be maintained, the combination of the open and closed states of the valves is changed to mode 3. Accordingly, the chambers in which the water flows is decreased from the second and third chambers 16, 17 to the third chamber 17. This means, that the heat transfer area is decreased, and the heat exchanger effectiveness is decreased. The temperature at the outlet port 12 is increased above that in mode 2, and is not lowered below the lower limit of the temperature range which is to be maintained.

Any one of the four modes can be selected by changing the combination of the open and closed states of the valves. Thus the temperature at the outlet port 12 is maintained within the desired range. These operations are also executed according to the change of the flow rate of the exhaust gas, or the change of the temperature or the flow rate of the water which flows between the inlet and outlet ports 13, 14 so that the temperature at the outlet port 12 can be

maintained within the desired range of temperature.

In Fig. 2, a heat exchanger 20 includes valves 1, 2, 3, 4, 5 which can change the direction of flow of the water, so that the total number of the valves is reduced. The valves 1, 3, 5 are three-way valves, and the valves 2, 4 are four-way valves. When the water does not flow into a chamber, for example, the first chamber in Fig. 2, the water in the chamber 15 can be discharged to a tank 21 via a discharge passage 22 by the pressure in the chamber 15. Consequently, the heat exchanger 20 is safe even if the water in the chamber 15 boils. The bypass passage 18 is from the valve 1 to the discharge passage 22 through the valves 3, 5. A pump 23 returns water from the tank 21 to the valve 1.

The operation of Fig. 2 is the same as Fig. 1; the combination of the valves 1 to 5 is as follows:

Mode	Chamber in which water flows	1	2	3	4	5
1	1,2,3 chambers	a	a	-	a	-
2	2,3 chambers	b	b	a	a	-
3	3 chamber	b	b	b	b	a
4	None	b	b	b	b	b

The directions a, b are shown in Fig. 2. Fig. 2 shows mode 2. When mode 2 is changed to mode 3, the water in the second chamber 16 can flow through the valve 4 to the tank 21 via the discharge passage 22.

The dimensions of the chambers 15, 16, 17 are the same and the mode is determined by the numbers of the chamber in which the water flows in Figs. 1, 2. If the dimensions of the 15, 16, 17 are different, or the heat transfer characteristics of the chambers 15, 16, 17 is made different by fins etc., the mode selected also takes into account to which particular chamber the water is supplied, in addition to the number of chambers in which the water flows. This means, that when the water is, for example, supplied to only one chamber, there is a difference in the heat exchange effectiveness according to whether the water is supplied to the first chamber 15 or the second chamber 16. Thus, when the number of modes is increased, the range in which the temperature at the outlet port can be maintained becomes narrower, or the function can be performed inspite of a bigger change of conditions at the inlet side, and the effect provided by the invention is increased.

CLAIMS

1. A heat exchanger comprising a number of portions, a passage for a fluid through the portions, a bypass passage, and valves for selecting whether the fluid passes through any of the portions or the bypass.

2. A heat exchanger according to claim 1 comprising a discharge passage for the fluid to a tank and a pump for returning the fluid to the portions.

3. A heat exchanger as herein described with reference to Fig. 1 or 2 of the drawings.

Printed in the United Kingdom for Her Majesty's Stationery Office, Dd 8818335, 1986, 4235.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.